

Penn Cambria Curriculum

Course Name	Trigonometry/Pre-Calculus
Length of Course	1 credit – 1 period per day in 18 week block schedule
Grade Level	10-12
Prerequisites	85% or higher in Keystone Algebra 2
Course Description	This is a rigorous course designed for a one-year Pre-calculus course that follows Keystone Algebra II. Students who successfully complete this course will be prepared to take a Calculus course or any other fifth year advanced mathematics course. Calculator and computer based graphing technology are incorporated in this course to enhance the teaching and learning of pre-calculus mathematics.
Units of Study	Linear and Quadratic Functions Polynomial Functions Inequalities Functions Exponents and Logarithms Analytic Geometry Trigonometric Functions Trigonometric Equations and Applications Triangle Trigonometry
Materials	Text: <u>Advanced Mathematics</u> ©2003 – Brown - Houghton Mifflin Supplemental Materials: Graphing calculator

Standard alignment based on final draft PA Academic Standards for Mathematics (c2010).

Unit 1: Linear and Quadratic Functions

Estimated Time: 10 Days

Standard Alignment:

- 2.1.11.A – Model and compare values of irrational and complex numbers.
- 2.1.11.B – Use factoring to create equivalent forms of polynomials.
- 2.1.11.E – Apply the concepts of prime and composite polynomials to determine GCFs (Greatest Common Factor) and LCMs (Least Common Multiple) of polynomials.
- 2.2.11.C – Evaluate numerical expressions that include the four basic operations of powers and roots, reciprocals, opposites, and absolute values.
- 2.5.11.A – Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts..
- 2.8.11.B – Evaluate and simplify algebraic expressions and solve and graph linear, quadratic, exponential, and logarithmic equations and inequalities, and solve and graph systems of equations and inequalities.
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.

Curricular Objectives:

A. Points and Lines

- a. Find the distance between two points
- b. Identify the midpoint of a segment given the endpoints
- c. Find the intersection of two lines
- d. Solve a system of linear equations algebraically

B. Slopes of Lines

- a. Find the slope of a line given any two points on the line
- b. Find the slope of a line given the equation of the line in any form
- c. Find the slope of a line given the graph of the line
- d. Determine whether two lines are parallel or perpendicular

C. Equations of Lines

- a. Find the equation of a line given the intercepts
- b. Find the equation of a line given two points on the line
- c. Find the equation of a line given the slope and y-intercept

D. Linear Functions

- a. Evaluate a function at any value in its domain
- b. Find the zero of a function
- c. Model a real-world situation as a linear function

E. Complex Numbers

- a. Find the square root of a negative number using imaginary numbers
- b. Add, subtract, multiply and divide imaginary numbers
- c. Perform the required to rationalize imaginary expressions

F. Quadratic Functions

- a. Solve quadratic equations by factoring, completing the square, and using the quadratic formula
- b. Sketch the graph of a quadratic function as a parabola and label the vertex, axis of symmetry, and all intercepts
- c. Solve a system of equations involving a linear and a quadratic equation

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 2: Polynomial Functions

Estimated Time: 12 Days

Standard Alignment:

- 2.1.11.B – Use factoring to create equivalent forms of polynomials.
- 2.1.11.E – Apply the concepts of prime and composite polynomials to determine GCFs (Greatest Common Factor) and LCMs (Least Common Multiple) of polynomials.
- 2.3.11.E – Describe how a change in the value of one variable in a formula affects the value of the measurement.
- 2.5.11.A – Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.5.11.B – Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F - Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.

Curricular Objectives:**A. Polynomials**

- a. Identify a polynomial function
- b. Evaluate a polynomial function using direct substitution
- c. Evaluate a polynomial function using direct substitution
- d. Find the zeros of a polynomial function

B. Synthetic Division

- a. Find the remainder of the quotient of a polynomial by applying the remainder theorem
- b. Determine if a given factor is a factor of a polynomial by applying the factor theorem

C. Graphing Polynomial Functions

- a. Graph an approximation of a cubic, quartic, and quintic function
- b. Determine the equation of a polynomial given its graph

D. Finding Maximums and Minimums of Polynomial Functions

- a. Find the maximum and the minimum of a polynomial equation
- b. Write a polynomial equation to describe a given situation, find the maximum and minimum value(s) of that function, and use those values to solve real-world problems

E. Using Technology to Find Roots of a Polynomial Equation

- a. Use a calculator to find the real roots of a polynomial equations
- b. Use Internet applications to find the real roots of polynomial equations

F. Solving Polynomial Equations by Factoring

- a. Solve a polynomial equation using various methods of factoring
- b. Solve a polynomial equation using the Rational Root Theorem

G. General Results for Polynomial Equations

- a. State and apply the Fundamental Theorem of Algebra
- b. State and apply the Complex Conjugates Theorem
- c. Write a quadratic equation given its roots

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 3: Inequalities

Estimated Time: 6 Days

Standard Alignment:

- 2.2.11.C – Evaluate numerical expressions that include the four basic operations and operations of powers and roots, reciprocals, opposites, and absolute values.
- 2.5.11.A – Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.5.11.B – Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.8.11.B – Evaluate and simplify algebraic expressions and solve and graph linear, quadratic, exponential, and logarithmic equations and inequalities, and solve and graph systems of equations and inequalities.
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.

Curricular Objectives:

A. Linear Inequalities; Absolute Value

- a. Solve and graph linear inequalities in one variable
- b. Solve and graph linear absolute value inequalities in one variable

B. Polynomial Inequalities in One Variable

- a. Solve and polynomial inequalities in one variable

C. Polynomial Inequalities in Two Variables

- a. Graph polynomial inequalities in two variables
- b. Graph a solution set of a system of inequalities

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 4: Functions

Estimated Time: 9 Days

Standard Alignment:

- 2.3.11.E – Describe how a change in the value of one variable in a formula affects the value of the measurement.
- 2.8.11.B – Evaluate and simplify algebraic expressions and solve and graph linear, quadratic, exponential, and logarithmic equations and inequalities, and solve and graph systems of equations and inequalities.
- 2.8.11.D – Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, trigonometric, exponential, and logarithmic).
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.
- 2.10.11.B – Graph periodic and circular functions; describe properties of the graphs.

Curricular Objectives:

A. Functions

- a. State the properties of a function
- b. Determine the domain, range, and zeroes of a function

B. Operations on Function

- a. Perform function addition, subtraction, multiplication, and division
- b. Solve problems involving the composition of functions

C. Reflecting Graphs; Symmetry

- a. Given the graph of any function $f(x)$, draw the graph of $f(-x)$, $-f(x)$, and $|f(x)|$
- b. State the properties of symmetry in the x-axis, y-axis, the line $y=x$, and the origin

D. Period Functions; Stretching and Translating Graphs

- a. Determine the fundamental period and amplitude of a graph
- b. Draw the graph of a function by stretching and shrinking both horizontally and vertically
- c. Draw the graph of a function by translating

E. Inverse Functions

- a. Determine if a given function has an inverse
- b. Find the inverse of a function (if it exists)
- c. Graph the inverse of a function

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion
- Computer simulations

Unit 5: Exponents and Logarithms

Estimated Time: 11 Days

Standard Alignment:

- 2.1.11.A – Model and compare values of irrational and complex numbers.
- 2.1.11.F – Understand the concepts of exponential and logarithmic forms and use the inverse relationships between exponential and logarithmic expression to determine unknown quantities in equations.
- 2.2.11.C – Evaluate numerical expressions that include the four basic operations and operations of powers and roots, reciprocals, opposites, and absolute values.
- 2.5.11.A – Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.5.11.B – Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.8.11.B – Evaluate and simplify algebraic expressions and solve and graph linear, quadratic, exponential, and logarithmic equations and inequalities, and solve and graph systems of equations and inequalities.
- 2.8.11.D – Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, trigonometric, exponential, and logarithmic).

Curricular Objectives:

A. Integral Exponents

- a. Apply the laws of integral exponents to simplify exponential expressions with integral exponents
- b. Solve growth and decay problems dealing with integral exponents
- c. State and apply the formula for simple interest

B. Rational Exponents

- a. Simplify rational exponential expressions
- b. Simplify radical expressions
- c. Transform an expression from exponential form to radical form and from radical form to exponential form
- d. Solve growth and decay problems dealing with rational exponents
- e. Solve exponential equations
- f. State and apply the formula for compound interest

C. Exponential Functions

- a. Graph exponential functions
- b. State the half-life formula and solve half-life problems

D. The Number e and the Natural Logarithmic Expression

- a. Define the natural logarithmic function
- b. Graph the natural logarithmic function
- c. State and apply the formula for continuously compounded interest

E. Logarithmic Functions

- a. Write exponential equations in logarithmic form
- b. Write logarithmic equations in exponential form
- c. Find the value of a logarithm

F. Laws of Logarithms

- a. State the laws of logarithms
- b. Expand and condense logarithmic expressions using the laws of logarithms
- c. Solve logarithmic equations

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 6: Analytic Geometry

Estimated Time: 10 Days

Standard Alignment:

2.1.11.B – Use factoring to create equivalent forms of polynomials.

2.2.11.C – Evaluate numerical expressions that include the four basic operations and operations of powers and roots, reciprocals, opposites, and absolute values.

2.8.11.B – Evaluate and simplify algebraic expressions and solve and graph linear, quadratic, exponential, and logarithmic equations and inequalities, and solve and graph systems of equations and inequalities.

2.8.11.D – Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, trigonometric, exponential, and logarithmic).

Curricular Objectives:

A. Circles

- a. State the “center-radius” form of the equation of a circle
- b. Write the equation of a circle given its properties or its graph
- c. Given the equation of a circle, re-write it in center-radius form by completing the square
- d. Graph the equation of a circle by hand and using technology

B. Ellipses

- a. Sketch the graph of an ellipse given an equation
- b. Write the equation of an ellipse given the vertices, foci, and axes

C. Hyperbolas

- a. Sketch the graph of a hyperbola given an equation
- b. Write the equation of hyperbola given the vertices, foci, and axes

D. Parabolas

- a. Sketch the graph of a parabola given an equation
- b. Write the equation of a parabola given the vertex and directrix

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion
- Computer simulations

Unit 7: Trigonometric Functions

Estimated Time: 13 Days

Standard Alignment:

- 2.1.11.A – Model and compare values of irrational and complex numbers.
- 2.2.11.C – Evaluate numerical expressions that include the four basic operations and operations of powers and roots, reciprocals, opposites, and absolute values.
- 2.8.11.D – Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, trigonometric, exponential, and logarithmic).
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.
- 2.10.11.B - Graph periodic and circular functions; describe properties of the graphs.

Curricular Objectives:

A. Measurement of Angles

- a. Convert angle measures to and from degrees and radians
- b. Find positive and negative co-terminal angles

B. Sectors of Circles

- a. Determine the arc length of a sector of a circle
- b. Find the area of a sector of a circle
- c. Solve problems involving apparent size

C. The Sine and Cosine Functions

- a. State the definitions of sine and cosine
- b. Apply the definitions of sine and cosine to find values of these functions
- c. Solve simple trigonometric equations

D. Evaluating and Graphing Sine and Cosine

- a. Find the values of sine and cosine using reference angles
- b. Find the values of sine and cosine using calculators and tables
- c. Sketch the graphs of sine and cosine

E. The Other Trigonometric Functions

- a. State the definitions of tangent, cotangent, secant, and cosecant
- b. Find the values of the other trig functions using reference angles
- c. Find the values of the other trig functions using calculators and tables
- d. Sketch the graphs of the other trig functions

F. The Inverse Trigonometric Functions

- a. State the definitions of the inverse trigonometric functions
- b. Find the values of the inverse trigonometric functions

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 8: Trigonometric Equations and Applications

Estimated Time: 10 Days

Standard Alignment:

- 2.1.11.A – Model and compare values of irrational and complex numbers.
- 2.1.11.B – Use factoring to create equivalent forms of polynomials.
- 2.2.11.C – Evaluate numerical expressions that include the four basic operations and operations of powers and roots, reciprocals, opposites, and absolute values.
- 2.5.11.A – Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.5.11.B – Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.8.11.D – Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, trigonometric, exponential, and logarithmic).
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.
- 2.10.11.B - Graph periodic and circular functions; describe properties of the graphs.

Curricular Objectives:

A. Simple Trigonometric Functions

- a. Solve a trigonometric equation and
- b. Write the solution of a trigonometric equation in both degrees and radians
- c. Given the slope of a line, find the angle of inclination
- d. Given the inclination of a line, find the slope
- e. Given the inclination of a line and a point on that line, find the equation

B. Sine and Cosine Curves

- a. Given a sine or cosine function state its period and amplitude
- b. Given the graph of a sine or cosine function write its equation

C. Relationships Among the Functions

- a. State the common trigonometric identities
- b. Simplify trigonometric equations using the identities

D. Solving More Difficult Trigonometric Equations

- a. Use the trigonometric identities to solve difficult trigonometric equations

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion

Unit 9: Triangle Trigonometry

Estimated Time: 9 Days

Standard Alignment:

- 2.1.11.A – Model and compare values of irrational and complex numbers.
- 2.1.11.B – Use factoring to create equivalent forms of polynomials.
- 2.3.11.C – Use properties of geometric figures and measurement formulas to solve for a missing quantity (e.g., the measure of a specific angle created by parallel lines and a transversal).
- 2.8.11.E – Use combinations of symbols and numbers to create expressions, equations, and inequalities in two or more variables, systems of equations and inequalities, and functional relationships that model problem situations.
- 2.8.11.F – Interpret the results of solving equations, inequalities, systems of equations, and inequalities in the situation that motivated the model.
- 2.10.11.A – Identify, create, and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem.
- 2.10.11.B - Graph periodic and circular functions; describe properties of the graphs.

Curricular Objectives:

A. Solving Right Triangles

- a. State the trigonometric relationships of right triangles
- b. Solve right triangles using trigonometry
- c. Solve angle of inclination and angle of depression problems

B. The Area of a Triangle

- a. State and apply the trigonometric formula for the area of a triangle

C. The Law of Sines

- a. State the law of sines
- b. Apply the law of sines to solve a triangle

D. The Law of Cosines

- a. State the law of cosines
- b. Apply the law of cosines to solve a triangle

Assessments/ Measurement of Objectives:

- Objective quizzes and tests
- Graded homework exercises

Suggested Methods of Instruction / Learning Activities:

- Lecture
- Computer-aided instruction
- Guided practice
- Drill and practice
- Peer-to-peer instruction/tutoring/discussion
- Class Discussion